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**Central banks’ interest rate and international trade in BRIC countries: agriculture vs  
machinery industry?**

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**Abstract.** The paper investigates interrelations between the dynamics of national central banks’ interest rates and international trade within the BRIC countries. It shows that countries with lower interest rates experience growth of the share of machinery industry exports rather than agriculture and food products, and, on the contrary, in countries with higher interest rates the share of agriculture and food exports increases and the share of machinery industry products declines. The investigation has shown that a relative shift in the interest rate can affect the specialization of countries.

**Keywords:** Central banks’ interest rate, Exports, Specialization

**JEL code:** F1

# 1 INTRODUCTION

The conventional theory of international trade holds that labor-abundant countries try to export products with more labor as an abundant factor used to manufacture them (Ohlin 1933); however, the recent decades have seen enough examples where labor-abundant countries changed their comparative advantage (South Korea, Taiwan), giving up their agricultural specialization, and, as a result, rapidly increasing their welfare. Therefore, the study of factors that affect changes in the specialization of countries is of great scientific and practical interest. One of such factors is a favorable investment climate, which is based on the central bank's interest rate. This paper considers interrelations between the refinance rate within the BRIC countries (Brazil, Russia, India, and China) and changes in their export structure.

Papers that deal with the development of international trade use the notions of rent and capital value, while specific problems of how the central bank's interest rate affects international trade find insufficient coverage.

Lower rates create better conditions for investments, which are channeled, among other things, into the production sphere (including the manufacture of high-tech products). A decrease in the central bank's interest rate improves the macroeconomic environment (in fact, for all industries, including agriculture) and increases production output and exports.

High levels of interest rates interrupt economic growth in different countries: in Europe in the 1980s' (Blanchard 2004), in South Africa in the 1990s' (Aron and Muellbauer 2002). Low levels of interest rates help create better conditions for investment in the production of goods, including high-tech products. As the central bank cuts down interest rate, the macroeconomic condition for all sectors of the economy, including agriculture, gets better, the production of goods grows and exports increase.

In times, when the economy gets into recession, into a financial crisis, the central banks' interest rate may increase in order to reduce the cost of the local currency and open the economy for foreign direct investments (Aizenman 1999).

On the other hand, not only global problems, like the financial crisis, can affect the shifts in central banks' interest rate. The specific factors of the economy in the particular country can also be significant. For example, the growth of the national debt leads central banks to rise the interest rate (Engen and Hubbard 2004).

The dynamics of the central bank's interest rate (or the fixation of this rate at a certain level) leads to relevant transformations in the economies of the BRIC countries, ultimately affecting their export structure: the share of agriculture and food products<sup>1</sup> either decreases or increases, and the percentage of engineering products either increases or decreases.

It is assumed that the structures of developed economies differ from those of developing economies in a lesser share of agriculture and in a greater share of machinery industry in their GDP and, consequently, in their exports. Proceeding from this, changes related to the growing share of machinery industry exports and the shrinking share of agriculture exports reflect a more or less advanced nature of changes in the economy. This work investigates the interrelation between the level of the central banks' interest rate and the nature of changes in the exports of the BRIC countries.

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<sup>1</sup> Sometimes we will call it "agrifood" production for simplicity or when we talk of the economy sector – "agrifood" sector. Its because we analyze not only the agriculture raw products but also the processed products.

This paper has the following structure. Section 2 consistently investigates the chain of interrelations between changes in the central banks' interest rate and export dynamics, as well as changes in the export structure of the BRIC countries. The dynamics of the shares of machinery industry products and agriculture and food products in the export structure are evaluated, as well as their interdependence. Section 3 focuses on bilateral trade between the BRIC countries. Section 4 justifies changes in the export structure affected by the refinance rate. Section 5 generalizes on the main results and presents conclusions.

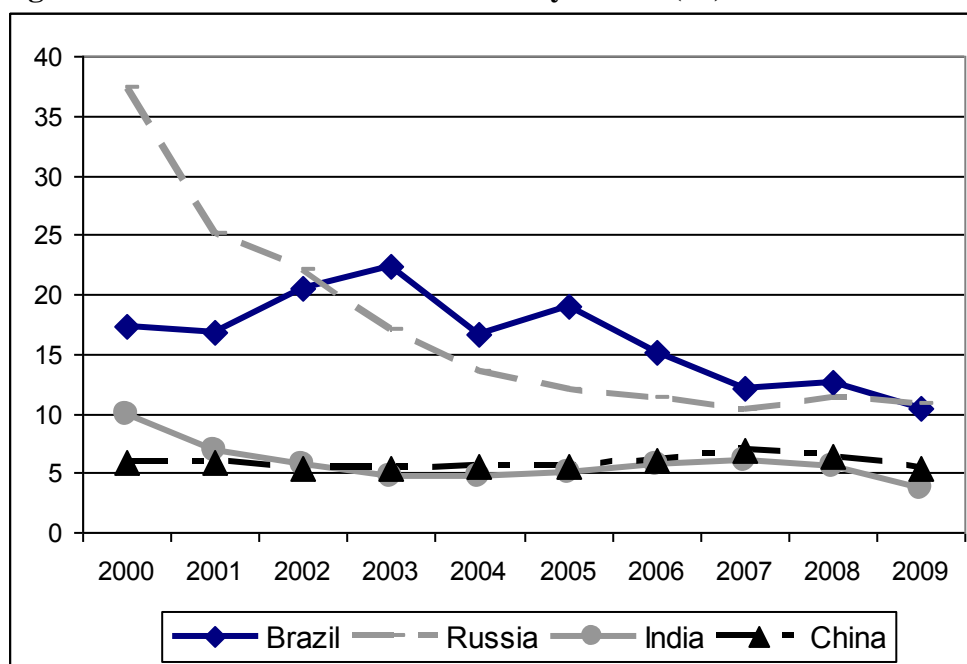
## 2 THE INFLUENCE OF THE REFINANCE RATE ON THE EXPORT STRUCTURE

This paper assumes that the national central bank's interest rate principally affects bank credit rates; therefore, we will not analyze bank credit rates in this paper. Note that a change in the refinance rate does not always trigger the adequate dynamics of credit rates; nevertheless, this assumption is necessary to simplify further analysis.

The central bank's interest rate depends both on the inflation rate and on a number of other factors. Since the size of the central bank's interest rate reflects the specific conditions of functioning of the economy of a given country, we assume that it is based on the principle of rationalization of all activities with regard to financial assets available, reflecting the value of capital in the country.

Over the past decade, many countries have had a trend to reduce their central bank's interest rates, this trend being amplified by the financial crisis. Thus, the central bank's interest rates in the BRIC countries mainly decreased (see Fig. 1). Despite the relative rapprochement of rates owing to their mutual reduction, average values (calculated by their nominal values) are differentiated: 5.8% in China (over the period 2000-2009) and 5.8% in India; however, the Chinese rate remained actually stable; in India it decreased more than two times; in Brazil the average rate was 16.3%; and in Russia, 17%.

**Figure 1: Central banks' interest rates dynamics (%)**



Sources: [www.cbr.ru](http://www.cbr.ru), [www.topforexnews.com](http://www.topforexnews.com), [www.tradingeconomics.com](http://www.tradingeconomics.com), [www.fxstreet.com](http://www.fxstreet.com)

The interest rate dispersion for China over the 2000-2009 period under consideration was minimal, 0.242; therefore, its impact was not due to its dynamics but due to its stabilization at a sufficiently low level. In India, dispersion was slightly higher, 2.524; for Brazil and Russia, dispersion values were 12.860 and 69.043, respectively, which implies the rate instability.

The average interest rate for a period of several years characterizes the ability of a country to keep it at a certain level with all resources available; therefore, rate averages for the period 2000-2009 are important for investigation.

**The central banks' interest rate and credits.** Many papers prove the effect of interest rates on investment growth. The reduction of interest rates in Brazil, India, and Russia and the stabilization of the refinance rate at a relevantly low level in China stimulated credit activities in the BRIC countries (see Table 1). The average relative indicators of bank loans granted over the period under study corresponded to the average interest rates: 134% in China, 60.3% in India, 54% in Brazil, and 22.4% in Russia (averages for 2000- 2008).

**Table 1: Domestic credit provided by banking sector (% of GDP)**

Countries	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Brazil	75	76	78	78	76	82	106	114	118	n.a.
Russia	25	23	25	27	26	21	25	28	26	n.a.
India	53	55	59	57	58	58	61	61	68	73
China	120	123	144	152	140	134	134	128	121	145

Notes: n.a. = not available.

Source: <http://data.worldbank.org/>

A relation between central banks' interest rates and bank loans (% of GDP) is proved by corresponding correlation values: -0.81 in Brazil, -0.69 in China, and -0.62 in India. In Russia, this indicator was only -0.16, which is explained by the low sensitivity of demand to loans under rate reduction, if the rate is reduced from one high value to another value still high.

**Loans and investments.** A reduction of the interest rate means a decrease in capital value and, in fact, turns on the "green light" for investments. Therefore, activation in the credit sectors of the BRIC countries stimulates the growth of investment processes. For example, correlation between loans (% of GDP) and investments into fixed capital (% of GDP) (see Table 2) was 0.255 for Brazil, 0.385 for China, 0.670 for India, and 0.443 for Russia.

Low enough correlation values in this case may not be always explained by the bank origin of investments; moreover, the response of firms to a loan rate reduction has a long time dynamics. According to the World Bank, the percentage of firms that attract bank loans to finance investments into Russia grew from 11.1% in 2002 to 30.6% in 2009; in Brazil over the 2003-2009 period, it increased from 27.8 to 48.4%; and in India in 2006 it was 46.7%. At the same time, correlation in the absolute value of loans and investments yields a more encouraging result: 0.573 for Brazil, 0.991 for China, 0.971 for India, and 0.736 for Russia.

**Table 2: Gross capital formation (% of GDP)**

Countries	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Brazil	18	18	16	16	17	16	17	17	18	17
Russia	19	22	20	21	21	20	21	24	26	23
India	24	24	25	27	32	34	36	38	36	35
China	35	36	38	41	43	44	44	42	43	45

Source: <http://data.worldbank.org/>

In some cases the specific conditions of financial markets in some countries make interference to the growth of investments. This happens if banks buy too many government bonds at a low rate, this may hinder the growth of investments (Jerald Schiff et al 2005).

Foreign direct investments (FDIs) into the BRIC economies are relatively small (see Table 3); meanwhile, their high productivity thanks to the diffusion of new technologies (Daniel Gros, 2008) can affect the situation in this or that sector. Some papers (E. Borensztein and al 1998) assert that FDIs can be even more productive than domestic investments at a high level of human development (the presence of secondary-school education).

Thus, we can speak about significant differences in the investment climate of the BRIC countries: this criterion gives unconditional leadership to China, followed by India and Brazil and, finally, Russia rearing the four.

**Table 3: Foreign direct investments (% of GDP)**

Countries	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Brazil	5	4	3	2	3	2	2	3	3	2
Russia	1	1	1	2	3	2	3	4	4	3
India	1	1	1	1	1	1	2	2	3	3
China	3	3	3	3	3	4	3	4	3	2

Source: <http://data.worldbank.org/>

**Investments and production in the BRIC countries.** When the central banks' interest rate is reduced, the cost of credits decreases, which encourages the decrease of loan and deposit rates, the growth of corporate investments and personal expenditures, and, ultimately, GDP growth. Among papers that substantiate interrelations between the interest rate and GDP dynamics, we should single out (Albu L.-L. 2010).

Investment activity stimulates the redistribution of resources; as a result, profitable industries develop, and unprofitable industries phase out. For higher rates of refinance, investment processes become selective and with the minimal risks for capital; as a rule, this is the development of noninnovative sectors. Low rates are more characterized by investments into high-tech production. In other words, relatively low refinance rates stimulate the development of science-intensive industries and industries with a high value added (machinery industry), while relatively high refinance rates form mainly traditional production with a relatively low value added (for example, agriculture).

**Table 4: GDP (billion USD)**

Countries	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Brazil	645	554	504	552	664	882	1 089	1 366	1 639	1 572
Russia	260	307	345	431	592	765	989	1 300	1 668	1 231
India	460	478	507	599	721	837	949	1 233	1 214	1 310
China	1 198	1 325	1 454	1 641	1 932	2 257	2 717	3 506	4 533	4 985

Source: <http://data.worldbank.org/>

The effect of interest rates on GDP growth does not show at once; it has a deferred character. Therefore, we have to take into account a time lag between a decrease in the refinance rate and the beginning of the related changes in production. Some works (Neumeyer and Perri 2004) show that it takes 3-9 months to see the effect from shifting the interest rate in the GDP dynamics. Since we want to know how the interest rate relates not only to GDP but to exports, we consider a one year lag on export from the shift in the interest rate.

Taking into account the fact that the Chinese interest rate has been rather stable, we think that the relevantly low level of the rate itself stimulated investments into production.

Thus, the interest rate dynamics in 2000-2008 affected the BRIC countries' GDPs in different ways. In 2001-2009, China's GDP increased 3.8 times; India's, 2.7 times; Brazil's, 2.8 times; and Russia's, 4.0 times.

**BRIC's investments and export.** The export of goods and services has been growing most dynamically in China and India, i.e., in the countries with the lowest average interest rates (see Table 5). Over the period 2001-2009, the export of goods from China increased 4.5 times<sup>2</sup>; from India, 4.0 times; from Russia, 2.9 times; and from Brazil, 2.6 times.

**Table 5: Exports of goods and services (billion USD)**

Countries	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Brazil	64	66	71	83	106	132	152	178	229	204
Russia	114	113	121	151	201	268	336	390	517	369
India	60	62	71	90	130	159	199	259	291	328
China	276	305	363	492	657	835	1 060	1 332	1 586	1 296

Source: <http://data.worldbank.org/>

Correlation between investments and the export of goods and services (especially, goods) in India and China (see Table 6) shows that investments flowed primarily into sectors whose products were exported. Likewise, correlation indices between investments and imports in these countries show interrelation between investments and import purchases. Brazil and Russia have reverse interrelation between investments and exports, which implies that these countries primarily invest into sectors that are not export oriented.

**Table 6. Correlation between investments (2000-2008) and foreign trade indices (2001-2009)**

Countries	Exports of goods and services (% of GDP)	Imports of goods and services (% of GDP)	Exports of goods (% of GDP)	Imports of goods (% of GDP)
Brazil	-0,71	0,49	-0,8	0,16
Russia	-0,74	-0,54	-0,85	0,35
India	0,95	0,97	0,91	0,93
China	0,8	0,64	0,84	0,68

Source: own calculation based on the data from <http://data.worldbank.org/> and <http://www.trademap.org>

In addition, Russia's negative correlation between investments and imports indicates investments into national production industries oriented toward domestic demand.

High-technology products occupy a certain place in the export of the BRIC countries; this dynamics also allows us to clarify the direction of economic changes there. The most dynamic growth of high-technology exports is in China (see Table 7); then follow India and Brazil by a landslide; and Russia rears the four. This share in Russian exports decreased from 17% in 2000 to 7% in 2008. Over the same period, the percentage of high-tech products in Brazil's export decreased from 19 to 12%. In India, this indicator has stabilized at 5-6%.

<sup>2</sup> International Trade Centre, Trade Map – International Trade Statistics, <http://www.trademap.org>.

**Table 7: High-technology exports (billion USD)**

Countries	2000	2001	2002	2003	2004	2005	2006	2007	2008
Brazil	6	6	5	5	6	8	8	9	11
Russia	4	3	5	6	5	4	4	4	5
India	2	2	2	2	3	3	4	5	6
China	41	48	68	108	162	214	271	337	381

Source: <http://data.worldbank.org/>

Thus, the BRIC countries with the growing export (and production) of high-technology products have relatively low central banks' interest rates.

The dynamics of machinery industry exports from India and China was higher than from Russia and Brazil, while the highest growth rates in agricultural production were in Russia and Brazil and the lowest, in China and India. The growth of machinery industry exports vs. agrifood exports in India and China was 1.79 and 1.22, and in Brazil and Russia, 0.495 and 0.492, respectively.

Changes in the export structure of the BRIC countries were considered. Since a higher share of machinery industry vs. agribusiness characterizes a more developed type of the economy, we studied the dynamics of the shares of the machinery industry (product group codes 84-90) and agrifood (codes 1-2,4-24,52)<sup>3</sup>.

**Table 8: The share of machinery industry products in exports (%)**

	2001	2002	2003	2004	2005	2006	2007	2008	2009
Brazil	27	25	24	26	26	25	24	22	18
Russia	8	9	8	6	4	4	4	4	4
India	9	9	11	11	11	12	12	15	16
China	38	41	45	48	49	50	51	51	53

Source: own calculation based on the data from International Trade Centre, Trade Map – International Trade Statistics, <http://www.trademap.org>.

**Table 9: The share of agriculture and food products in exports (%)**

	2001	2002	2003	2004	2005	2006	2007	2008	2009
Brazil	29	29	30	29	27	27	28	29	36
Russia	1,6	2	2	1	2	2	2	2	3,3
India	19	17	16	14	12	12	13	13	10
China	7	7	6	5	4	4	4	3	4

Source: own calculation based on the data from International Trade Centre, Trade Map – International Trade Statistics, <http://www.trademap.org>.

The export share of the machinery industry in China's total exports over the period 2001-2009 has grown from 37.8 to 52.9% (see Table 8), and the export share of agrifood products has decreased from 6.2 to 3.4% (see Table 9). In India, the share of machinery industry increased from 9.5 to 16.2%; consequently, the share of agrifood products decreased from 15.7 to 9.3%. In Brazil, agrifood exports have, in fact, replaced machinery industry exports: the share of engineering exports decreased from 27.5 to 17.7%, and the share of food products increased from 28.1 to 35.6%. In Russia, the share of machinery industry products decreased from 7.6 to 4.4%, while the share of agrifood products increased from 1.6 to 3.3%.

Thus, the analysis of the BRIC foreign trade shows that between 2001 and 2009 China and India, the countries with the lowest average interest rates, reduced the share of agricultural and food

<sup>3</sup> Group 52 (cotton) was added taking into account the BRIC specifics.



products and increased the share of machinery industry products in the structure of their exports; moreover, correlation between these shares of product groups was -0.961 and -0.762, respectively. Brazil and Russia, countries with the highest interest rates, have been experiencing the opposite processes: the share of machinery industry products has been decreasing, and the share of agrifood products has been growing, correlation between the shares of machinery industry products and agrifood products in these countries being -0.846 and -0.150, respectively.

In China and India the growth rates of agricultural exports fell behind the growth rates of the total exports of these countries by 2.8 and 1.3 times, respectively (see Table 10). In Russia and Brazil, on the contrary, agricultural exports have been growing ahead of their total export growth rates by 2.1 and 1.2 times, respectively. Table 10 shows us that the value and the growth rates of agrifood exports were much higher in Brazil and Russia than in India and China.

**Table 10: Agrifood exports from BRIC (billion USD)**

Countries	2000	2001	2002	2003	2004	2005	2006	2007
Brazil	13	16	17	21	27	31	35	43
Russia	13	13	14	17	17	21	22	28
India	5	5	6	7	7	9	11	17
China	1	1	2	2	2	3	4	8

Source: <http://faostat.fao.org/>

Table 11 shows that Brazil is the biggest food exporter for the BRIC countries, and the biggest food importer is Russia.

**Table 11: The average share of agrifood in the bilateral exports in the BRIC countries in the 2001-2009 period (%)**

Exporters	Importers			
	Brazil	Russia	India	China
Brazil	x	93,3	37,1	37,2
Russia	0,1	x	2,9	1,6
India	3,5	28,4	x	12,0
China	1,9	7,4	2,2	x

Source: own calculation based on the data from International Trade Centre, Trade Map – International Trade Statistics, <http://www.trademap.org>.

### 3 BILATERAL TRADE BETWEEN THE BRIC COUNTRIES

The export structure of the BRIC countries' bilateral trade differs from the structure of the total export of each of these countries. In particular, they do not always have this high dependence between the shares of industrial and agricultural products. This is explained by the fact that the exports of these countries are also oriented toward the markets of other countries. At the same time, the highest correlations between the shares of industrial and agricultural exports are observable in Brazilian export to Russia (-0.976) and in Chinese export to India (-0.862) and to Russia (-0.716).

*Brazilian exports to the Russian Federation* are 1.9% (2009) of the total export, mainly, meat and sugar. The share of the machinery industry export to Russia over the period 2001-2009 has somewhat grew from 0.4 to 0.9%, and the share of agrifood industries decreased from 98 to 96.4%.

Brazilian export to China also has its commodity tenor (ore and slag, oilseeds) and amounts to 13.2% of the total export (2009). The share of this country's machinery industry exports to China over the period 2001-2009 decreased from 18.4 to 3.3%, the share of agrifood products having increased from 34.0 to 36.7%.

Brazil exports mainly sugar and mineral fuel to India, the share of Brazilian export to India in value terms being 2.2% (2009). The share of machinery industry exports to India decreased from 20.5 to 6.1%. Consequently, agrifood exports in absolute values have increased 10.8 times (however, its share has somewhat decreased from 56.6 to 51.3%)<sup>4</sup>.

**India** exports 1% of its total exports to Brazil (mainly, mineral fuel), 5.9% to China (ore and slag), and 0.5% to Russia (pharmaceuticals, coffee, and tea) (2009). In its trade with the BRIC countries, the share of India's machinery industry export increased 1.1 times to Brazil, 1.6 times to China, and 3.1 times to Russia. At the same time, the share of agricultural and food exports to China decreased two times but increased 1.3 times to Brazil and 1.1 times to Russia.

**Chinese export** to the other BRIC countries was small: 1.2% to Brazil (mainly, electric equipment, engineering products, optical instruments, and organic chemicals), 2.5% to India (electric equipment, engineering products, and organic chemicals), and 1.5% to Russia (engineering products, electric equipment, footwear, and clothing) (2009).

The share of machinery industry exports to Brazil, India, and Russia increased 1.3, 2.4, and 3 times, respectively. At the same time, the share of agrifood exports to Brazil increased 1.1 times, and that to India and Russia decreased 2.1 and 1.4 times, respectively.

**Russia** sends 0.3% of its total exports to Brazil (fertilizers and ferrous metals), 1.7% to India (engineering products, fertilizers, and vehicles), and 5.6% to China (mineral fuel, timber, and ferrous metals) (2009)<sup>5</sup>.

The share of Russian machinery industry exports to Brazil increased 1.7 times, the share of agrifood products also increasing from 0.03 to 0.05%. The share of machinery industry exports to China decreased 1.9 times, and the share of agrifood exports increased 2.4 times. The share of machinery industry exports to India increased 1.1 times and the share of agrifood exports increased from 0.22 to 0.8.

Thus, in the majority of cases, exports from BRIC countries with lower interest rates to BRIC countries with higher interest rates show growth in the share of machinery industry products and downfall in the share of agrifood products.

Exports from BRIC countries with higher interest rates to BRIC countries with lower interest rates mainly shows a drop in the share of machinery industry products and growth in the share of agrifood products.

The original "center of gravity" for the BRIC countries is China, and trade between the BRIC countries themselves, except for the Chinese export, is of raw-material nature.

In order to establish a trend that amplifies or weakens trade relations between the BRIC countries; let us consider a ratio of a change in export trade between one BRIC country and another BRIC country (by pair) to a change in the total exports of this country over the period 2001-2009. For example, for Brazil, we see that its export to China increased 10.6 times, and

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<sup>4</sup> Hereinafter, the change in the shares of product groups over 2001-2009.

<sup>5</sup> Source: International Trade Centre, Trade Map - International Trade Statistics, <http://www.trademap.org>.

Brazil's total export increased 2.6 times. Consequently, the relative growth of export to another BRIC country was  $10.6/2.6 = 4.1$  times.

Analyzing exports from each BRIC country, we will obtain the following results (see Table 12).

**Table 12: Relative dynamics of exports to the BRIC countries in 2001-2009**

Exporters	Importers			
	Brazil	Russia	India	China
Brazil	<b>x</b>	1	4,6	4,1
Russia	1,8	<b>x</b>	1,5	1
India	2	0,3	<b>x</b>	2,7
China	2,3	1,4	3,5	<b>x</b>

Source: own calculation based on the data from <http://www.trademap.org>.

By the indices of relative dynamics in mutual export growth, countries with the highest credit activity are in the lead; they are China and Brazil; for India, this index is lower; and, finally, Russia has the lowest dynamics.

**Table 13: Bilateral trade in BRIC (billion USD)**

Two-way trade	2001	2002	2003	2004	2005	2006	2007	2008	2009	2009/2001
Brazil to China	2	3	5	5	7	8	11	16	20	10,6
Brazil to India	0,3	0,7	0,6	0,7	1,1	0,9	1,0	1,1	3,4	12,0
Brazil to Russia	1,1	1,3	1,5	1,7	2,9	3,4	3,7	4,7	2,9	2,6
China to Brazil	1	1	2	4	5	7	11	19	14	10,5
China to India	2	3	3	6	9	15	24	32	30	15,6
China to Russia	3	4	6	9	13	16	29	33	18	6,5
India to Brazil	0,2	0,5	0,3	0,5	1,0	1,5	1,9	3,3	1,8	8,0
India to China	1	2	3	4	7	8	9	10	10	10,8
India to Russia	0,8	0,7	0,7	0,6	0,7	0,8	0,9	1,1	1,0	1,2
Russia to Brazil	0,2	0,2	0,3	0,4	0,6	0,7	1,1	2,0	1,1	5,7
Russia to China	6	7	8	10	13	16	15	21	17	3,0
Russia to India	1	2	3	3	2	3	3	5	6	5,3

Source: own calculation based on the data from <http://www.trademap.org>.

Finally, note that the largest exports in the BRIC bilateral trade flow to countries with the lowest refinance rates (see Table 13), and this happens regardless of the country of export origin.

This case, probably, may be explained by the Samuelson theorem (Samuelson, 1949), since BRIC countries with a relatively low capital value buy more goods from BRIC countries with a

relatively high capital value. In fact, capital flows into countries with higher interest rates, i.e., to countries where it is a relatively deficient factor. The theorem's condition is the homogeneity of production factors in the trading countries. In our case, we mainly speak about capital that, if we speak about homogeneity, must be characterized by the same productivity and risk.

Since we are speaking about developing countries (BRIC), the degree of difference of capital by the criteria of productivity and risk may be significant but not as much as when we consider developed economies.

#### **4 THE REFINANCE RATE AND THE SPECIALIZATION OF THE BRIC COUNTRIES**

We should show that our findings are not arbitrary and can be duly justified.

Recently, capital mobility between countries has been growing more dynamically than labor mobility. Among the main causes are capital market liberalization, the emergence of new financial instruments, and the development and introduction of new means of communication. In these conditions, the opportunities to use the interest rate of a domestic central bank as an artificial instrument of government policy objectively shrink.

When a domestic company or bank is able to borrow a loan from a foreign bank or an international financial organization under more favorable terms, the market will start pushing the government to bring the refinance rate closer to the value at which domestic companies can borrow loans in developed countries. Ultimately, the government will have to reduce the refinance rate and gradually bring it closer to the level of capital-abundant countries<sup>6</sup>.

When the government keeps the refinance rate at an unreasonably high level and domestic companies borrow foreign loans, the financial sphere loses a large segment of consumer loans for the population and small and partly medium-sized businesses who cannot submit the relevant collateral to a foreign lender.

Thus, the reduction of the refinance rate activates domestic loans not only by increasing demand among former borrowers but also by adding more and more new borrowers to their number. The difference between the refinance rate and capital value is that the latter has one unique value at a certain moment in time, while the refinance rate can have one from a range of values<sup>7</sup>.

In conditions where capital value decreases due to cheap foreign loans, capital starts to travel between countries, leveling capital value in these countries, and this trend is gaining momentum. In particular, an indicator of capital flow is External debt stocks, private nonguaranteed (PNG) (current US\$), which over the period 2000-2009 in the BRIC countries was on average US \$102.4 billion for Brazil, US \$57.7 billion for China, US \$60.1 billion for India, and US \$110.9 billion for Russia<sup>8</sup>. Note that the average debt stocks in countries with higher average interest rates over the same period were higher than in countries with lower average interest rates. Private debt stocks increase at different rates.

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<sup>6</sup> The rate's bottom limit for the government must primarily be the inflation rate and the financial resources of the central bank (thus, when Russian banks find themselves in a liquidity crisis, they rely not on the central bank's loans but on the interbank credit market. Central bank loans comprise only 1-2% of all loans lent in a country.

<sup>7</sup> This artificial instrument in some cases creates an *illusion* of capital value.

<sup>8</sup> Source: World Bank.

The trend to reduce refinance rates has a mass nature; i.e. this process involves many countries. Growth in capital mobility leads to the rapprochement of refinance rates between labor-abundant and labor-deficient countries.

Despite a decrease in the refinance rate, Brazil and Russia are strengthening their specialization in the production of agrifood products, since a decrease in interest rates in Brazil and Russia should have reduced agrifood product exports and boosted machinery industry exports. However, the point is that the trend of lowering interest rates is practically universal. The decrease in absolute rate values occurred in many countries; in fact, the scale of rates has changed, but this has not affected the nature of economic processes in certain countries. The decline of the interest rates was a worldwide process during the 2000-2009 period. In some developed and developing countries it started even in the 1990s (Ricardo et al. 2006).

Moreover, in certain cases, capital value in a labor-abundant country may decrease so that, together with a lower labor value, the production cost of capital-intensive goods there can not only level with the production cost of the same goods in capital-abundant countries but also decrease even more.

The universal reduction of refinance rates and the consequent reduction of capital value until a certain point in time do not result in the increased output of capital-intensive goods in labor-abundant countries.

If we consider the two-good, two-factor model, then, in the conditions of autarky, capital value reduction would lead to a relative increase in the output of capital-intensive good and a relative decrease in the output of labor-intensive good. However, when a country participates in international trade, it will export a good whose free-market price is higher than the autarky price. Even if the refinance rate in a labor-abundant country decreases but the production cost of capital-intensive good in this country remains high, their producers will not risk exporting such good.

The two-good, two-factor model assumes that the production technology of each of the two goods is the same. In a capital-intensive industry (especially, in machine industry), the role of labor is lower; therefore, we may assume that, in these industries of the two countries, identical automated lines operate and technologies regulate in a certain (in fact, similar) manner the participation of labor in the production process. Consequently, the very technology of production of a capital-intensive good in the two countries limits the degree of variation between the relevant labor and capital costs to produce a unit of good.

Therefore, if the unit-cost function of a capital-intensive good (let us designate it as good 1) in a capital-abundant country is  $c(w, r) = wL_1 + rK_1$ , the corresponding function of the same good in a labor-abundant country will be  $c^*(w, r) = w^*L_1 + r^*K_1$ ,

where  $w, r$  are, respectively, the costs of labor and capital in a capital-abundant country,

$w^*, r^*$  are, respectively, the costs of labor and capital in a labor-abundant country,

$L_1, K_1$  are the corresponding contributions of the factors in the unit of capital-intensive good 1.

Consequently, if:

$$\begin{aligned} c^*(w, r) &< c(w, r) \text{ or} \\ K(r^* - r) &< L(w - w^*), \end{aligned} \tag{1}$$

the country rich in labor under certain conditions can develop the production and export of the capital-intensive good.

The growth of external demand for the capital-intensive good from a labor-abundant country will stimulate producers to use the deficient factor even more intensively. The intensification of its use will lead to a reduction in intensive capital use in the production of the labor-intensive good and to a gradual shift in specialization.

Let us give a general description of the international-trade model that can be used for more convincing justification of our findings. In this model, the capital flow between countries influences trade. The two-good, two factor model in this case will be supplemented by the following condition: one production factor (capital) can freely move between countries. Capital can only flow in one direction - to the capital-deficient country and its sector that produces capital-intensive goods. Capital owners are indifferent to which of the two countries will produce good; they are interested in receiving a higher rent; for these purposes, they lease production factors to the producers in the capital-deficient country.

Capital flow between countries is only possible under the condition  $\frac{c(w, r)}{c^*(w, r)} < 1$ . For the value of capital that flows between countries  $r^{**}$  holds the condition  $r < r^{**} < r^*$ .

Let us consider a capital-intensive industry in a capital-abundant country. Since capital outflows to the labor-abundant country, where potential costs can be lower, the industry's capital endowment will decrease.

Assuming that the amount of moving capital will not be too significant in relation to its resources in the two countries, we may assume that the prices of goods and factors will remain invariable. This condition will allow us to evaluate the impact of a factor (capital) on changes in the output of goods in each of the two countries.

In this case, using the "Jones algebra" (Jones 1965), we can show that, in the capital-abundant country, a capital outflow amount of  $\bar{K} < 0$ , under the invariable amount of labor  $\bar{L} = 0$ , will encourage a decrease in the output of the capital-intensive industry by a value of  $\bar{y}_1 = \frac{-\lambda_{2L}}{(\lambda_{2K} - \lambda_{2L})} \bar{K} < 0$ , and an increase in the output of the labor-intensive industry by

$$\bar{y}_2 = \frac{\lambda_{1L}}{|\lambda|} \bar{K} > 0, \text{ where the determinant } |\lambda| < 0, \text{ since } |\lambda| = \begin{vmatrix} \lambda_{1L} & \lambda_{2L} \\ \lambda_{1K} & \lambda_{2K} \end{vmatrix} = \lambda_{1L} - \lambda_{1K} = \lambda_{2K} - \lambda_{2L}.$$

$\lambda_{iL}$  is the fraction of the labor force employed in industry  $i$ ;  $\lambda_{iK}$  is the fraction of the capital stock employed in industry  $i$ ;  $\bar{y}_i$  is the percentage changes in the output of industry  $i$ ;  $\bar{K}$  is the percentage changes in capital; and  $\bar{L}$  is the percentage changes in labor.

In the labor-abundant country, as capital flows, capital endowment increases by the value of  $\bar{K}^* > 0$ , this being the case, labor endowment will not change either  $\bar{L}^* = 0$ .

Capital inflow to the labor-abundant country will lead to an increase in the output of capital-intensive good by  $\bar{y}_1^* = \frac{-\lambda_{2L}^*}{(\lambda_{2K}^* - \lambda_{2L}^*)} \bar{K}^* > 0$ , and to a decrease in the production of labor-intensive good by  $\bar{y}_2^* = \frac{\lambda_{1L}^*}{|\lambda^*|} \bar{K}^* < 0$ , where, for the labor-abundant country:

$\lambda_{iL}^*$  is the fraction of the labor force employed in industry  $i$ ;  $\lambda_{iK}^*$  is the fraction of the capital stock employed in industry  $i$ ;  $\bar{y}_i^*$  is the percentage changes in the output of industry  $i$ ;  $\bar{K}^*$  is the percentage changes in capital; and  $\bar{L}^*$  is the percentage changes in labor.

In variable prices conditions capital inflow will facilitate growth in the production of capital-intensive good in the labor-abundant country, and this growth will continue until the prices for these goods level out in the conditions of international trade. International trade equilibrium will be reached under the condition of zero profit (the prices of goods here will equal the costs); the conditions of the full employment of resources will also be met.

Thus, we have established that, in the export structures of the BRIC countries with relatively high interest rates (Brazil and Russia), the share of machinery industry products relatively decreases, and that of agrifood products relatively grows. The two other BRIC countries (China and India) show the opposite trend.

Three BRIC countries (net of Russia) show a high enough correlation between machinery industry and agricultural and food exports. Despite the absence of a significant correlation in the case of Russia, the share of machinery industry products in its exports is also decreasing, and the share of agrifood exports is also increasing.

Since Brazil and Russia are countries with higher welfare than China and India, the BRIC countries are a good example where two wealthier countries are relatively losing (to a different degree) their future prosperity, and two poorer countries are relatively gaining it.

Since low interest rates operate in developed economies with relatively high shares of machinery industry exports and relatively low shares of agricultural and food products exports, we may assume that the BRIC countries should have such interest rate by reaching which these countries would be inclined to change their specialization.

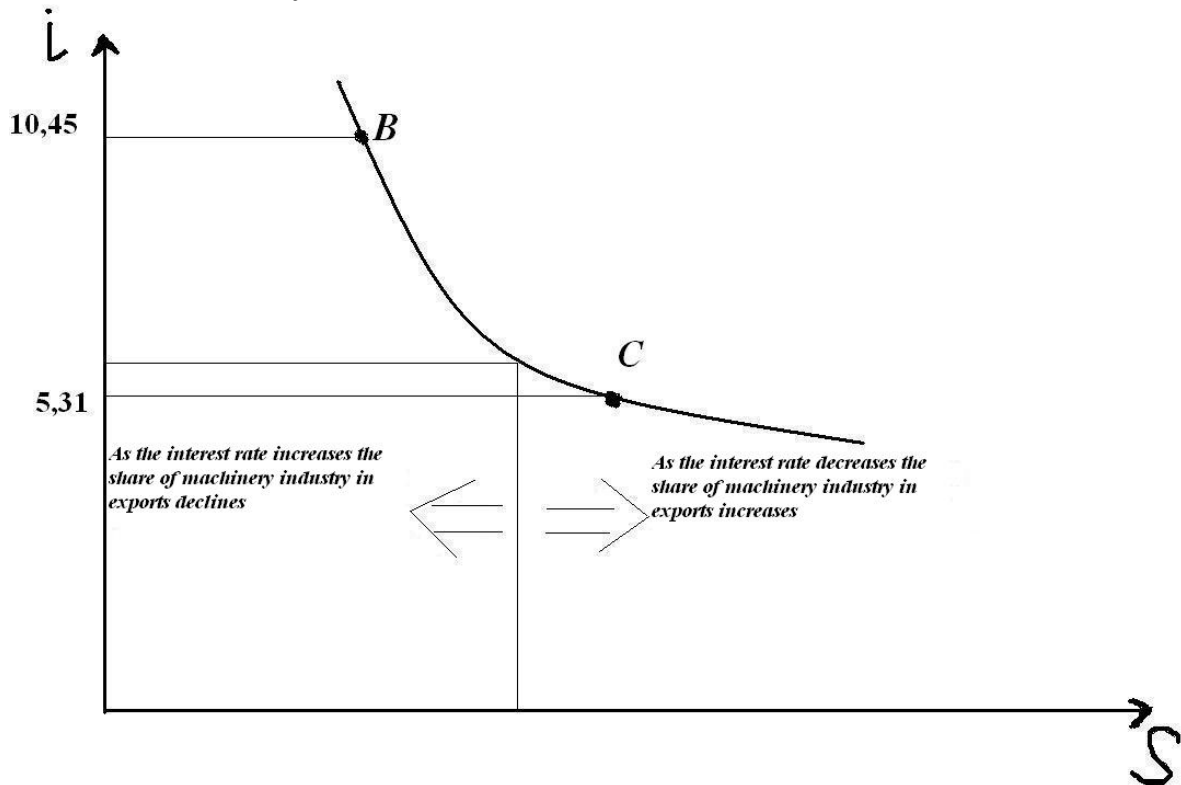
For example, a relatively quick drop in interest rates would bring changes in the export structures of Brazil and Russia similar to those that are happening in China and India; i.e., a quick enough decrease in interest rates in Russia or Brazil against the same rates in India and China may create more favorable conditions for the preferential development of machinery industry in these countries. At any rate, such changes in the specialization of the BRIC countries are possible not only theoretically, and the practical experience of some Asian countries proves this.

The Figure 2 shows that for the BRIC countries, the range within which the refinance rates that change specialization as of 2009 fall is limited to 5.31 (China) at the bottom and 10.45 (Brazil) at the top<sup>9</sup>.

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<sup>9</sup> To set a narrower range of the rate that would separate countries by specialization, we need to analyze more countries.

**Figure 2: The response of the specialization to shifts in interest rates in the BRIC countries (the condition of the year 2009)**



Notes:  $i$  – interest rate,  $s$  – share of machinery industry products in exports.

A generally unusual situation has occurred in the BRIC countries with low interest rates. For example, it is assumed that there are countries with low capital values and relatively high labor value, and, vice versa, there are countries where capital is a relatively expensive factor and labor is cheap.

In China and India, capital value is relatively low (if we assume that the interest rate is the basic component of capital value); at the same time, an average labor cost is much lower than in Brazil and Russia. Thus, China and India have reached a unique combination of low values of capital and labor, which allows us to view them as countries with a high potential for economic growth.

## 5 CONCLUSION

The analysis of trade in the BRIC countries with different applicable interest rates has shown that the interest rate affects their export structure, which is shaped by the countries' production specialization.

In the majority of cases, the export of the BRIC countries with lower interest rates to the BRIC countries with higher interest rates is characterized by an increase in the industrial share and a decrease in the agrifood share. In turn, the export of the BRIC countries with higher refinance rates to the BRIC countries with lower refinance rates is mainly characterized by a decrease in the industrial share and an increase in the agricultural and food products share.



The conventional theory of international trade cannot explain all the situations in the changes of a certain country specialization. Nevertheless, it is still a significant problem, especially for developing countries. This paper explains how the low cost of capital (this role plays the central banks' interest rate) affects the specialization in the BRIC countries.

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